An Instrument for Inspecting Aspheric Optical Surfaces and Components, Phase I

Completed Technology Project (2007 - 2007)

Project Introduction

This is a Phase I proposal to develop an extremely versatile optical inspection tool for determining the optical figure of aspheric optical components, such as test objects, aspheric mirrors, segment mirrors, and optical components that are not easily inspected with conventional interferometry. Modern optical design and manufacturing procedures have begun using such components more and more in routine applications to improve optical system capability. Since the optical tolerances achieved in the manufacture of such components have an important bearing on the performance capabilities of the systems that employ them, instrumentation and techniques for precision metrology are vital for quality assurance. Inspection tools required for these types of optical components have lagged the capability to manufacture them. The proposed work will demonstrate a technique for full aperture precision metrology of such optical components and is anticipated to yield instrument designs that incorporate an extremely robust, reliable, and accurate wavefront sensor for precision metrology of a transmitted or reflected wavefront, together with a projection system that covers the full aperture. The proposed wavefront sensor comprises a unique combination of digital holographic interferometry, Hartmann wavefront sensing, and adaptive optics that results in an extremely flexible tool. For the Phase I study, we propose to employ an existing wavefront sensor instrument to accelerate progress towards production of useful experimental data from tests conducted on existing optical elements.
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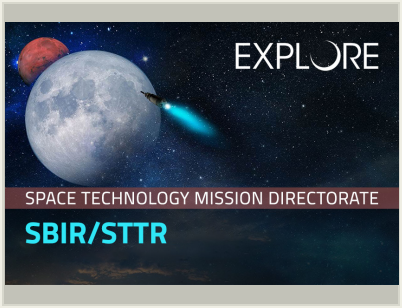
Anticipated Benefits



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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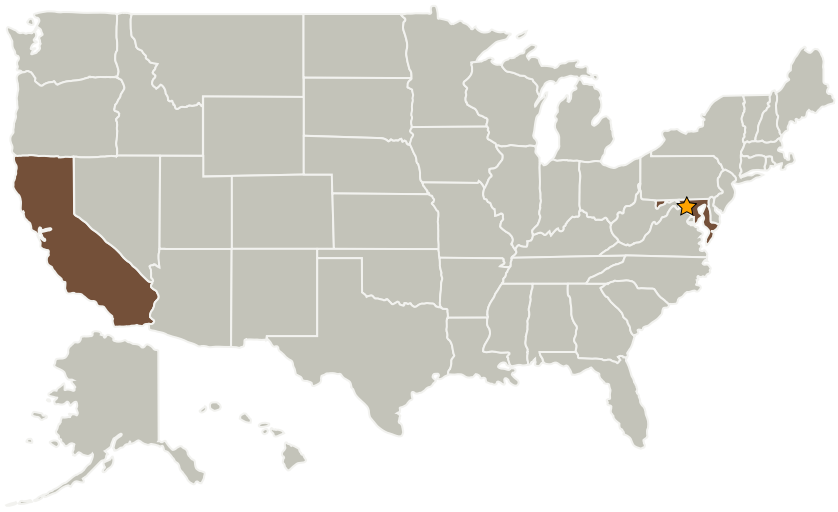
This program can provide a unique system for high accuracy testing of test objects and optics vital to a variety of military seeker and sensor systems. Both the US Army and the US Navy have requirements to develop metrology procedures for a new generation of infrared aspheric transmitting test objects with aerodynamic shapes that can depart from spherical by as much as millimeters. Further potential applications and commercial possibilities are predicted for systems employed in security monitoring, marine observation, and metrology. The ability to evaluate modern optical components to high tolerances is anticipated to provide new standards for manufacturing and quality control. This development will, therefore, have a corresponding and widespread impact on the performance capabilities of the many NASA systems that incorporate these components. The improvements gained by these measures may also provide substantial cost benefits compared to alternative, more complex, and expensive solutions. The versatile optical inspection system proposed here would be extremely valuable to NASA in manufacturing and acceptance testing of a wide variety of optics.

Primary U.S. Work Locations and Key Partners



Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Geraldine Wright

Principal Investigator:

James Trolinger

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.3 Electronics and Optics Manufacturing Process

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Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
MetroLaser, Inc.	Supporting Organization	Industry Minority-Owned Business, Small Disadvantaged Business (SDB)	Laguna Hills, California

Primary U.S. Work Locations	
California	Maryland